Purchased by
Bureau of Chemistry and Soils
Department of Agriculture
for official use

Published Monthly by
FLORIDA GROWER MAGAZINE, INC.
at Tampa, Florida

JOHN F. CUNNINGHAM, *President*
CHARLES G. MULLEN, *Vice-President*
MARVIN H. WALKER, *Secretary*

Entered as Second-Class Matter Feb. 3, 1911
at the Post Office at Tampa, Florida,
under act of March 3, 1879.

Florida Grower

FLORIDA'S GREATEST AGRICULTURAL AND HORTICULTURAL JOURNAL

The Magazine of Florida

Executive Officers
305 MORGAN STREET

305 MORGAN STREET
MARVIN H. WALKER, *Editor and Manager*
THOMAS HALL, *Circulation Manager*

Subscription Rates
United States, $1.00 a year
Foreign Countries, $2.00 a year

VOL. XLIII, No. 1 TAMPA, FLORIDA, JANUARY, 1935 WHOLE NO. 1,047

Preparation of Alcoholic Citrus Beverages

Some Aspects of the Problems of Commercial Manufacture Of Wines and Cordials from Surplus Florida Fruit Crops

By HARRY W. VON LOESECKE
U. S. Citrus Products Station, Bureau of Chemistry and Soils, Food Research Division, Winter Haven, Florida.*

REPEAL OF the 18th Amendment has created interest in the possibilities of preparing alcoholic beverages from surplus citrus fruits. The U. S. Citrus Products Station at Winter Haven has been engaged during the past year conducting researches in this field.

The manufacture of commercial alcoholic beverages must be bonded. Information on this subject as well as that upon regulations regarding the sale of alcoholic beverages may be obtained from the Alcohol Tax Unit, Bureau of Internal Revenue, Treasury Department; the Federal Alcohol Control Administration and the Food and Drug Administration at Washington, D. C. In addition to federal regulations, the manufacturer must comply with state and county laws.

Attention is also called to the fact that under Internal Revenue laws (T. D. 2765) a person may make unfortified wines not to exceed in any case 200 gallons per year, for the use of his own family, without payment of tax provided none of it is sold or otherwise removed from the place of manufacture.

This exemption does not apply to:

(a) Wines made by one person for the use of another, whether consumed on the premises or removed therefrom for the family use of the owner.

(b) Wines produced by a single person, unless he is head of a family.

(c) Wines produced by a married man living apart from his family and not for the use of that family, as in such case the wine is not made for family use.

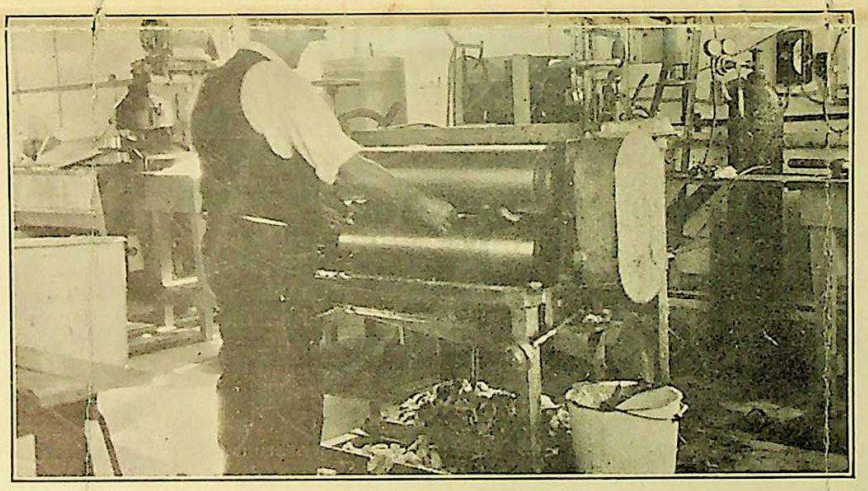
(d) Wines made by a partnership, or wines produced at a winery owned and operated by several heads of families jointly.

(e) Wines furnished ranch hands or boarders.

A person desiring to avail himself of this exemption must file a notice with the Collector of Internal Revenue before starting the manufacture of the wine. It is, of course, necessary to comply with the provisions of state and local laws.

Preparing Citrus Wines

Citrus wines cannot be prepared in the same manner as grape wines. Grapes contain from 16 to more than 24 percent sugar, which can be fermented to yield a wine of sufficient alcoholic strength to possess stable keeping qualities. Citrus fruits (oranges, tangerines and grapefruit) on the other hand, contain only from 6 to 8 percent sugar. When such juice is fermented the resulting wine would have an alcoholic content of only 3 to 4 percent, and not only would be unpalatable, but would not keep. It is therefore necessary to add sugar to the juice prior to fermentation. In this connection, the present federal regulations state



Pressing oil from citrus peel in preparation of cordials

"that wines may be manufactured on bonded winery premises from berries or fruits and sufficient sugar or sugar solution may be used before or during fermentation to correct natural deficiencies provided such correction does not increase the volume of the original material more than thirty-five percent. Where a bona fide need is demonstrated for the use of more sugar or sugar solution a greater quantity may be allowed. Such product may not be designated wine without qualification but the word wine must be prefixed by the name of the berry or fruit from which produced. This ruling does not pertain to grape wine . . . ."

The amount of sugar to be added to citrus juices depends upon the Brix reading of the original juice. In general, sufficient sugar is added to increase the Brix to 24 or 25 degrees. This will yield a wine containing approximately 13 percent alcohol by volume, if fermentation is carefully controlled. Either cane or corn sugar may be used. Corn sugar gives a more rapid and complete fermentation and is somewhat cheaper than cane sugar. Raw sugar is not desirable; it makes the wine dark in color and gives it a molasses like taste.

Theoretically, the aroma and taste of wine is dependent to a great extent upon the culture of the yeast used. In our experimental work we have used several different types of wine yeast, but the product has not aged enough for us to decide which culture is the best to use. We obtained good results by the use of *Saccharomyces ellipsoideus*, var, champagne, which ferments citrus juices completely and rapidly under favorable conditions. This culture may be obtained from the American Type Culture Collection, John McCormick Institute for Infectious Diseases, at Chicago, Illinois, for $2.00 per culture plus mailing charges. To obtain uniform results pure cultures should be used.

How to Use Yeast Culture

Unless one is familiar with bacteriological procedure there is some danger of contaminating the culture during propagation and inoculation. Special yeast culturing equipment is used for the more refined technic. The culture is received in a tube containing a special jelly, upon which the yeast is growing. The layman may expect success in using the culture if he will adhere strictly to the following directions:

Scald a clean pint bottle in boiling water for 20 minutes.

Add about a tablespoon of sugar (either corn or cane) to half a pint of orange juice, (grapefruit or tangerine juice may be used).

Boil the mixture gently for about 15 minutes in a covered aluminum or agate kettle. While it is still boiling pour it into the scalded, hot, pint bottle, and plug the mouth of the bottle with fresh, clean, sterile absorbent cotton, which may be purchased from a drugstore.

Set aside to cool overnight.

When ready to use place the neck of the culture tube in a flame for a few seconds.

Remove the cotton plug from the tube and hold it between the fingers. Do not place it on a table as such treatment may contaminate it with mold, wild yeast and bacteria.

Now heat the neck of the pint bottle containing the orange juice in the same manner as the culture tube was heated.

Remove cotton plug from the bottle and hold it between the fingers.

* *Food Research Division Contribution No. 244.*

Proceeding of Florida State Horticultural Society – May 193X
"Possibilities – – – –" Loesecke

Fill the culture tube half full with the juice from the bottle.

Stir carefully with a stiff wire which has been heated to redness and allowed to cool. Do not touch the wire with the finger to see if it has cooled, as this would contaminate it. It will cool in about 20 seconds.

Pour the stirred liquid from the culture tube back into the bottle of orange juice.

Plug the bottle again with the same piece of cotton.

Set aside in a warm place (about 70 degrees).

In the meanwhile add about one cup of sugar to a gallon of citrus juice, and boil gently for 15 minutes in an aluminum or agate covered kettle.

Sterilize a clean, gallon bottle with boiling water, being careful not to break the bottle by too rapid heating.

Pour the hot juice into the hot bottle until it is about three-quarters full. Then plug with sterile cotton. Allow to stand until cool. The gallon of juice should not be prepared too far in advance as it may become contaminated if held longer than three days.

The pint bottle of juice should be in active fermentation 48 hours after inoculation. Shake it carefully to avoid wetting the cotton plug.

Flame the neck of the bottle.

Remove the plug and hold it between the fingers.

Pour three-quarters of the juice into the one gallon batch and plug with sterile cotton.

Shake carefully.

Heat the neck of the pint bottle, plug with sterile cotton, and set aside in the ice box. This may now be used to inoculate another pint of sterile juice.

The one gallon batch is now placed in a warm place. In about three days this will be in active fermentation.

Prepare a ten gallon container, which has been thoroughly cleaned with boiling water. If a barrel is used this should be steamed out, or treated three times with boiling water.

Fill container three quarters full with juice which has been prepared in a clean, strictly sanitary manner and is free from excessive amounts of peel oil. The juice does not have to be sterile.

Add ten pounds of sugar.

When dissolved add the one gallon of actively fermenting juice.

Plug with cotton and allow to stand in a warm place (65 to 75 degrees Fahrenheit).

Ten gallons of actively fermenting juice are sufficient to start 100 gallons of juice; 100 gallons of actively fermenting juice are enough to start 1,000 gallons of juice.

Note: The preparation of starters should be carried out in a clean room, as free of drafts as possible.

Sound Fruit Must Be Used

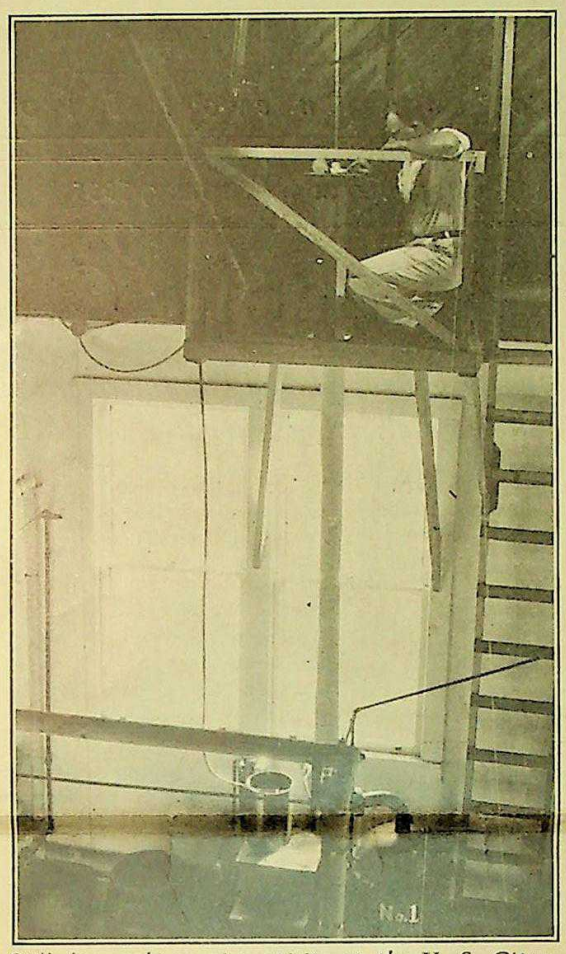
It is, of course, necessary to use sound fruit. The juice may be extracted by reaming, but the whole fruit cannot be crushed, for such a method would introduce too much oil from the peel which would render the finished product bitter. Significant amounts of peel oil will also retard fermentation.

It is not necessary to filter orange or tangerine juice, but grapefruit juice should be filtered absolutely clear before fermenting. This renders the finished wine less bitter. Subsequent aging also reduces the bitter taste of the product.

Citrus wines should be fermented at approximately 60 degrees Fahrenheit. This means that facilities for cooling the fermenting mass must be available. During the first few days of fermentation the temperature of the wine will rise and if not cooled may become warm enough to kill the yeast, but not the bacteria, which will thrive and impart an off-taste to the product.

* The manufacturer of wine will find "Laboratory Examinations of Wine and other Fermented Fruit Products" by Cruess, Joslyn and Marsh of value. This is published by the Avi-Publishing Co., New York, N. Y.

It is not necessary to have the fermenting tanks in a refrigerated room. Such a procedure would be too expensive. The tanks may be provided with coils through which brine circulates, but this method is not so efficient as pumping the wine from the fermenters through the coils immersed in a sump of brine, and then back again to the fermenter. In this way one sump may be used for many fermenters with a resulting saving in cost. The addition of ice directly to the wine in the tanks is not recommended.



Still for making wine spirits at the U. S. Citrus Products Station, Winter Haven, Florida

The fermenting tanks should preferably be constructed of redwood, but cypress may be used if the interior is covered with a resistant tank coating, several types of which may be found on the market to-day. Since cypress is porous, souring may develop unless the tanks are kept scrupulously clean.

Citrus wines in many instances will not "clear" in the same way as grape wine and therefore must be given a different treatment. Fermentation of the wine is usually completed in about ten days, but may be determined accurately by analyses of the alcohol content and residual sugar of the wine*. It should be clarified, by passing it through a plate and frame press, several types of which may be found on the market. After filtering, it is ready for storage. To store the wine in barrels at this stage is neither necessary nor desirable; allow it to age in large storage tanks of either redwood or white oak. The tanks should be well filled and fitted with a tight cover.

Before the wine is put in storage it should have an alcoholic content of at least 13 percent by volume and a total sugar content of not more than 5 percent nor less than 3 percent. Such wine would not be a dry wine within the meaning of the definition**. Experiments in producing a dry citrus wine have not been satisfactory.

Aging of wine in large storage tanks may be carried out at atmospheric temperatures prevailing in Florida, and no artificial cooling is necessary. If dry wines are made, however, lower temperatures are necessary.

**A dry wine from grapes is one having "less than 0.1 gram of sugar per 100cc of wine." That is, the sugar content would be less than 0.1 percent.

We do not as yet have sufficient data to state the optimum length of time citrus wines should age. However, preliminary tests seem to indicate they are quite palatable after storage of about six months. Only further tests will reveal whether longer storage will improve their quality.

Up to this point we have discussed citrus wines of about 13 percent alcoholic content. Experiments have indicated that citrus wines to which citrus wine spirits have been added to increase the alcoholic content to approximately 18 percent have a more pleasing aroma and taste, closely approaching that of sherry. Present regulations, however, will not permit the fortification of citrus wine with citrus wine spirits. Under the fortification act, this process is deemed an act of rectification and requires a rectifier's license, therefore it cannot be carried out in a bonded winery. Further, the rectifier must pay a tax of $2.00 per proof gallon on the spirits used for rectification and in addition pay a tax of 30 cents a gallon on the tax-paid wine so rectified. In view of these facts, the addition of citrus wine spirits to citrus wine would be unprofitable.

Cordials and Liqueurs

Citrus wine spirits are prepared by distilling citrus wines. The present regulations do not permit the addition of sugar to citrus juices prior to fermentation if a brandy is to be made. Therefore the yield of citrus brandy is extremely low as compared with the yield of brandy from other fruits. The table below will make this clear:

FRUIT	YIELD IN GALS. OF 100 PROOF BRANDY PER TON OF FRUIT.
Apples	27
Peaches	22
Pears	22
Apricots	21
Strawberries	14
Cherries	22
Grapes (California)	50
Grapes (other than California)	30
Citrus (grapefruit and oranges)	6.5 to 7.0

It is apparent from this table that it would not be economical to purchase fruit, however cheap, extract the juice and then ferment to make brandy. Purchasing waste juice from canneries, however, may be practical. Such juice should be purchased by the distiller according to its sugar content, to preclude any dilution with water. This waste will amount to about three-quarters of a gallon per field box processed in the cannery.

Cordials and liqueurs have been made from citrus by adding sugar and different essential oils to citrus wine spirits. The finest imported cordials are made in a similar manner, using cognac as a base. Domestic cordials are usually made from ordinary grain alcohol with added flavoring materials. We believe the manufacture of citrus cordials and liqueurs using citrus wine spirits as a base is economically feasible. Although Americans are not large consumers of cordials and liqueurs, they could probably be educated to partake of this type of liquor. In that case, a distinct and different cordial or liqueur with citrus as a base would have commercial possibilities.

In addition to what has already been said, those contemplating the manufacture of citrus wines should recognize the following facts:

Approximately 85 percent of the grape wines sold today are fortified. Because of the present regulations, fortified citrus wines can not be made to compete with these grape wines. If the regulations were modified to permit the fortification of citrus wines, such a product would likely find a market, but it is doubtful whether a still citrus wine of 13 percent alcohol content would be welcomed by the drinking public.

A large percentage of the drinking public today seems to demand a beverage of higher alcoholic content than offered by wines. Gin, brandy and whiskey are in great favor. Because of the present regulations, citrus brandy cannot be profitably made to compete with drinks high in alcoholic content.